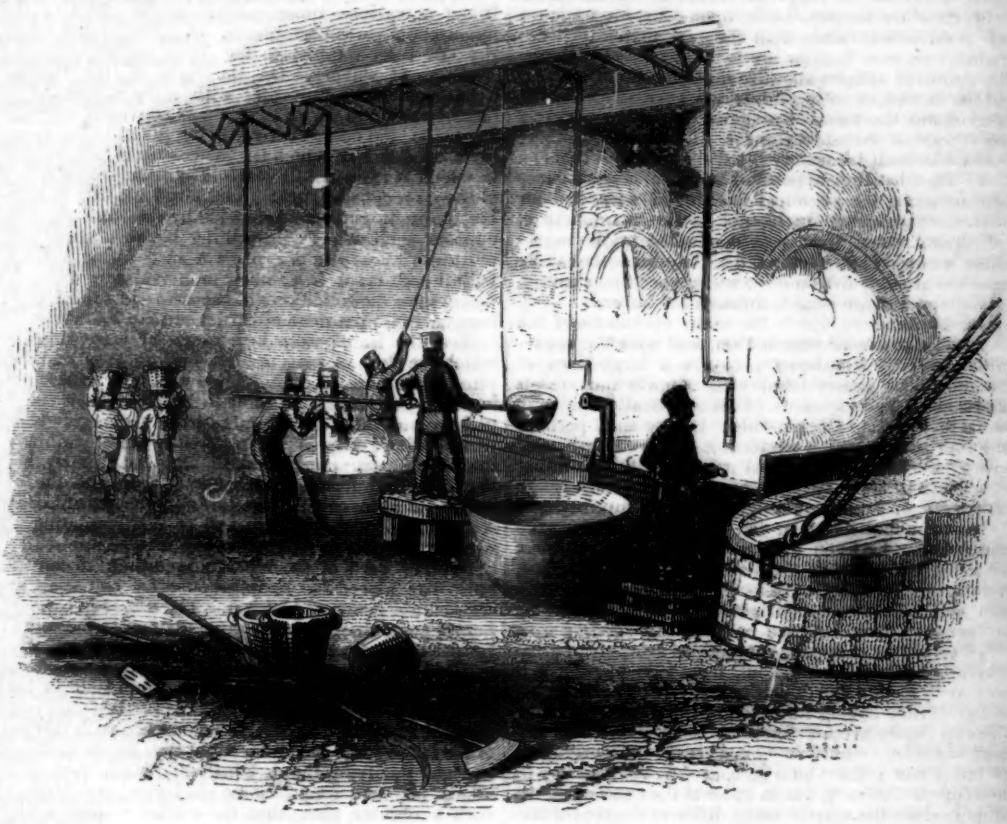
A DAY AT A SOAP AND CANDLE FACTORY.



[Soap-Boiling Coppers.]

If the reader will ramble some fine morning to that little green oasis in the great world of London—the Temple Gardens, and glance across the river, he will see immediately opposite to him a tall, black, bulky chimney, distinguishable from those which surround it by its large dimensions, and sending up its contribution to the smoky atmosphere of the metropolis. This chimney, and the buildings with which it is connected, point out the spot to which our attention will be directed in the present paper. It is true, the buildings present few of those attractions pertaining to "river scenery," nor do they add much to the famed beauties of the "banks of the Thames;" but they furnish an indication—one among many—of the commercial features of the metropolis, which are by no means devoid of interest.

We must quit the Temple Gardens, and cross Blackfriars Bridge to the Surrey side of the water, in order to reach the spot in question. The "way to wealth" in London, is generally through some narrow, dirty, dark, and crowded street, bounded on either side by ranges of factories, warehouses, or wharfs; with waggons and porters and cranes and bales of goods meeting the eye at every few steps. A street called Upper Ground Street, leading westward from Blackfriars Road at a short distance from the river, although it may not have a distinguished character as a "way to wealth," is certainly both narrow and dirty, and leads to many large factories and warehouses, most of which are situated in a part of the line called the Commercial Road, forming the communication between Upper Ground Street and the Waterloo Bridge Road. Among these factories, on the northern side of the Commercial Road, and occupying the space between it and the river, is the one to which our attention will be here directed, viz. the Soap and Candle Factory of Messrs. B. T. and W. Hawes; these gentlemen having with great courtesy permitted us to inspect and describe the operations conducted at this establishment.

This factory occupies the site where Queen Elizabeth's Barge-House formerly stood; a building wherein the state barge appears to have been kept, and to have undergone the necessary repairs. A creek or dock of some kind or other existed, into which the state barge was brought, but of which no vestiges now remain. A narrow pathway or passage leads down on the eastern side of the factory to the water's edge, and is known as 'Old Barge-house Stairs.' In the old maps of London, the 'Old Barge-house' is indicated as existing on this spot; but about a century ago the house ceased to be named, and we then find 'Old Barge-house Stairs' indicated. After the barge-house was removed, a glass-factory was established here; but about seventy or eighty years since, the manufacture of soap was commenced at this spot.

On entering the outer gates of the factory, we

find ourselves in an open court, with a dwelling-house immediately on the left, a range of low buildings on the right, a counting-house and offices nearly in front, and adjacent to the latter the entrance to the main buildings of the factory. In the open court are waggons and carts, laden either with the raw materials from whence soap and candles are to be made, or with the manufactured articles about to leave the premises. Of the offices and counting-house we need say nothing; they contain the usual arrangements for the partners and clerks in the establishment. Contiguous to these offices is a small laboratory fitted up with a furnace, a sand-bath, a distilling apparatus, and other conveniences for conducting the chemical analysis of soap, and for making experiments incidental to the manufacture. The manufacture of soap is conducted in the warehouses westward and northward of the offices; the candle department eastward; and we will glance first through the former, and afterwards through the latter.

The building in which the main operations of the soap-manufacture are carried on, and which is represented in our frontispiece, covers a large area of ground, and is nearly filled with coppers and vessels of considerable dimensions. It is technically known in the factory as the 'Copper-side;' but we shall perhaps be better understood if we term it the 'boiling-house.' As we pass along the central avenue of this building from south to north, we have on the right hand a range of coppers or boilers, nearly a dozen in number, and averaging about eight or ten feet in diameter, the height being between four and five. These coppers are filled with soap or the materials for its formation, in various stages of progress. In one the soap is nearly in a finished state, and is about to be removed; in another the ingredients are boiling, and sending up a profuse volume of steam; into a third a supply of alkaline liquor is being conducted, from vats wherein it is prepared; from a fourth the spent ley or liquor is being pumped, after having imparted its alkaline property to the soap; some are for 'mottled' soap, some for 'yellow,' some for 'white' or 'curd' soap. According to the time when the 'boiling-house' is visited, so will these operations vary, but in general the contents of the coppers show the soap in many different degrees of formation. These coppers, as in many other instances, are oddly termed, for they are in reality iron vessels surrounded with brick. No flues or fires of any kind are connected with them; the boilers are heated by steam which is constantly passing from a large boiler which supplies all these vessels, and which is situated in another part of the factory. The introduction of the method of heating by steam instead of fire, in soap factories, sugar refineries, and other establishments, is one of the most important improvements of modern times; economizing space and fuel, maintaining an equable temperature, and lessening the liability to accidents by fire. In each copper is a pump, for removing the spent ley at a particular period in the process.

Along the left hand of the avenue, through the boiling-house and opposite the boilers, is a row of alkali vats, in which the alkali is brought into a purified and liquid state. The alkali employed in soap-making, and which is a crude carbonate of soda or of potash, is brought to the factory in a dry greyish powder; but before it can be used in the manufacture, the carbonic acid must be removed from the alkali, leaving the latter in a caustic state. This we shall explain further on; but we here merely observe, that the vats in which this purification takes place are situated a few feet to the left of the boiling-coppers, and that a shoot or trough conducts the liquid alkali from the vats to the coppers.

Adjoining the boiling-house on the left is a passage leading down to the water, through which is conveyed the carbonate of lime resulting from the purification of the alkalis, a residuum which is extensively used as a manure on stiff lands. Its beneficial effect is much increased by the small quantity of alkali and salt which it contains. Very interesting accounts have been published at various times exhibiting the effect of this manure on particular plants. A considerable quantity has been shipped to the West Indies since the abolition of slavery. On the right of the boiling-house, and communicating with it by a door, is the 'frame-room,' to which the soap is conveyed after being made; the name of *frame* being given to the vessel or receptacle into which the made soap is poured, and in which it remains till cold. The frame-room is full of these receptacles, nearly a hundred and fifty in number, lying in ranks or rows side by side, and the rows opposite each other. In walking between these rows of frames we see in one place a man filling a frame with liquid soap; in another, men taking a frame to pieces after the solidifying of the soap; in a third, other men cutting up a mass of hardened soap into slabs.

Near the frame-room is a range of warerooms, in which the slabs of soap are cut up into bars, and then piled up in tiers, like bricks in a wall. If "cleanliness is next to godliness," according to the old adage, we ought to have very pleasant thoughts while passing between these walls of soap—here 'mottled'—there 'yellow'—in another part 'curd,' and so on; but the truth is, that the odour from such a mass of soap, and the unavoidable absence of cleanliness in the manufacture, somewhat disturb the pleasure of contemplating the ulterior purpose to which the soap is to be applied.

In other parts of the factory, according to convenience, are placed the boiling-house for soft soap, and warehouses connected with it. The soft-soap copper is heated and managed in the same manner as the coppers for the hard soaps, and holds fourteen or fifteen thousand pounds of soap. As this kind of soap is not of such consistence as to enable it to be cut into slabs or bars, it is packed in barrels and sent from the factory in a pasty or semi-fluid state. In connection with this part of the factory too, are six or eight vats for de-carbonizing and purifying the carbonate of potash used as the alkali for soft soap. Some factories are built on such a regular plan, that the visitor retains a clear notion of the relative positions of the several parts; but in the present case the connecting doors, passages, and stories, between one part of the factory and another, are so tortuous and perplexing, that we cannot be properly topographical in our details. We can only say, therefore, in respect of other parts of the soap-department, that in one place is a storeroom or warehouse for tallow; in another, a similar depository for alkalis; in a third, for resin (an important ingredient in yellow soap); in a fourth, for oil; in another for 'kitchen-stuff,' an ingredient in the commoner kinds of soap. There is one room in which barrels of palm-oil are kept, and in which the oil—solid in our climate—is melted out of the cask through the bung-hole by means of steam. In another spot the oil thus melted is purified and bleached, and brought into a state fit for the soap-manufacture. Other rooms, or portions of rooms, are devoted to various subsidiary processes relating to the soap-manufacture; but to which we need not pay particular notice.

After having visited the various portions of the soap-department, we glanced through the candle-department, which, although much less considerable in size, presents many ingenious arrangements and many curious applications of the division of labour. The principal room in this department is that in which the 'dip' or 'store' candles are made, and which we may perhaps term the 'dipping-room.' This is, to the eye of a stranger, the most singular-looking room in the factory. It is of considerable height, having two stories

or floors, one extending over the bottom in the usual way, and the other forming a kind of gallery round the four sides, at the height of about twelve feet from the floor. An inclined plane leads down from the gallery at one end to the floor at the other, consisting of a platform with ledges of wood at distances of about a foot asunder, forming a kind of an apology for a flight of stairs: it is, indeed, a kind of staircase, such as is used by ship-builders to ascend the sides of a ship, and is adapted by the smallness of its angle of elevation for the ascent of persons carrying loads. The floor or ground of the room is devoted to the manufacture of the candles, and the gallery to some subsequent operations. Along the middle of the floor is a row of cisterns, filled with tallow in a hot and melted state, which is kept at a proper temperature. Around the room on all four sides, and distant a few feet from the cisterns, are reservoirs or vessels of melted tallow, filled from the central cisterns, and consumed in the process of making candles. Between and above are candles, or the skeletons of candles, hanging in thousands; some having had only a single garment of tallow to cover the nakedness of the wicks; some more plentifully coated; and some nearly in a finished state. On three sides of the room men are making candles by the aid of the machines which we shall speak of by and bye; while in other parts of the room other men are 'dipping' according to the method in use before the invention of the machines. Here, a man is replenishing the supply of hot tallow in his dipping-cistern, from the cisterns in the middle of the room; there, is a boy removing the made candles from the machines, and fitting on a new supply of wicks; while other men and boys are busied in various parts of the manufacture.

On ascending the inclined plane to the gallery, we see near the outer edge of the gallery candles hanging on sticks; and round the gallery, next the wall, are a series of work-benches or tables, at each of which a man and a boy are engaged, the one to weigh the candles, according as they are 'eights,' 'tens,' 'twelves,' &c.,—denominations too well known to every housewife to need explanation; and the other to fasten the candles on a string. In a small room attached to the candle department is kept the store of rushes for making rushlights; they are gathered in Lancashire, and brought to town in bundles weighing a few pounds each. In another room are sacks or bags filled with cotton, wound up in balls of about three pounds weight. There is also a beautiful machine, at which a man is engaged in making wicks for 'mould' and 'dip' candles. A third room, larger than those just alluded to, is the 'mould-room,' in which the mould candles are made, by the aid of an elaborate and ingenious machine. Connected with the candle department, also, are the requisite stores and warerooms for the commercial arrangements of the establishment.

Besides the various buildings and rooms belonging particularly to the soap or candle departments of the factory, there are mechanical and other arrangements of a general kind, which need not much description. In convenient parts of the factory are two steam-engines of different horse-power. Near these is a blacksmith's shop, for the repair and adjustment of various kinds of iron-work used in the factory. The smoke from the different flues and furnaces is conducted into a square or rather pyramidal chimney of large dimensions, being twenty-one feet square at the bottom, six feet square at the top, and a hundred and twenty feet in height. A carpenter's shop furnishes the conveniences for making packing-cases, boxes, &c. for the commercial department. Lastly, and perhaps to the manufacturers the least pleasant of all—there are rooms and offices fitted up for the Excise-officers, one or more of whom are in the factory day and night. It is a great blot upon the fiscal arrangements of this country, and one which seriously affects the manufacture of malt, of glass, of soap, and many other articles, that in order to collect the duties levied on these commodities, the officers of the Excise are empowered to control, as it were, every step of the processes, and to regulate the extent to which any improvement in the operations may be carried. It is not the amount of duty collected to which we here refer; this is another subject: it is the mode of collection which is so objectionable, by imposing impolitic checks to the natural course of improvement in manufacturing processes. Considerable ameliorations have, within a recent period, been made in the mode of collecting the revenue, and the survey of the premises of soap manufacturers; and under the able superintendence of the present chairman of the Excise (Mr. Wood), the manufacturers feel confident that, odious as the collection of the Excise revenue must be, every facility consistent with the security of the revenue will be afforded for the introduction of improvements and the protection of the fair trader.

It is almost impossible to calculate the benefits which would result to our manufactures if the Excise could be abolished, or the amount of the tax so reduced as to remove the temptation for the commission of frauds. The fair trader is doubly injured by them; he is injured by the reduction he is obliged to submit to in the price of his commodity, in consequence of the competition with the smuggler, and almost to a greater degree from the restrictions which are necessarily imposed upon him for the protection of the revenue. These oblige him to manufacture not according to his judgment, but as directed by law; the ignorant and intelligent are thus placed upon the same footing, and the dishonest or fraudulent trader is in a more advantageous position than either. The success which has attended the reduction of the duty from 28*l.* to 14*l.* 14*s.* per ton proves the truth of these observations, and could this amount be further reduced, so that, like the penny postage, soap should be within the reach of all, no one who has studied the statistics of this manufacture can doubt but that in a short time, by lessening fraud, and increasing consumption, a larger revenue would be produced. The quantity of soap charged with duty for *home consumption* had been decreasing from 1828 to 1832, the year preceding the reduction, when the duty was charged upon 91,000,000 lbs. In 1834, the year after the reduction, it increased to 104,796,000 lbs., showing an increase of 14 per cent. in two years. It has since gradually increased to 127,000,000 lbs. in 1840. This quantity, however, it is believed does not indicate accurately the total quantity made. The population of Great Britain is now 18,540,000. The most accurate calculations prove that the consumption of soap in the families of artizans earning from twenty to thirty shillings per week is 10 lb. per head per annum, and in families above this class from 12 lbs. to 25 lbs. per head. Now, the quantity used per head in 1840 was 6¼ lbs., a smaller quantity than is used in workhouses or prisons, or than is allowed to soldiers; but if half only of the population are in such circumstances as to use the quantity ascertained, by very extended inquiry, to be used by artizans, and making no allowance for the extra quantity used by the other classes, we are driven to the conclusion either that nearly one-half of our population use no soap, or that a very large quantity is made and not charged with duty. To these facts the attention of the Excise is now directed. A superior class of officers is being introduced, and it appears likely that whilst the maker will no longer be subject to unnecessary or vexatious restrictions at the caprice of an exciseman, greater security will be afforded to the revenue.

We must now return to the factory, and having noticed the arrangement of coppers, boilers, engines, frames, moulds, cisterns, pumps, &c., it may be well to give such an account as the nature and object of this paper permit, of the operations conducted therein, and of the steps by which certain raw materials are converted into the well-known forms of soap and candles. Strictly speaking, there is a great deal of chemical nicety involved in the manufacture, both in theory and practice; but this is not the place where such matters can be consistently treated in a scientific manner. A rapid sketch of the nature and sources of the materials employed, and of their gradual transformation into the manufactured articles, will fill up the measure of our object.

Soap is designated in the 'Penny Cyclopædia' as a compound derived from the union between fat or oily substances and alkalis; and the nature of its formation is expressed in the following terms:—"It has been found by Chevreul that different varieties of fatty matter consist chiefly of two parts: one hard, to which he gave the name of stearin; and the other soft, which he termed olein. He also discovered that stearin is composed of stearic acid, and a peculiar principle, which, on account of its sweet taste, he named glycerin. When, in the manufacture of soap, an alkali (soda for example) is heated with tallow, the soda gradually dislodges the glycerin from combination with the stearic and oleic acids, and by combining with them, forms soap, or, in other words, a compound of stearate and oleate of soda, and the glycerin remains in solution." That the manufacture of this substance from the two classes of ingredients here mentioned has been long known is sufficiently indicated by a circumstance mentioned by Mr. Parkes in his 'Chemical Essays':—"On examining the excavations that were made on the spot where this famous city (Pompeii) formerly stood, a complete soapboiler's shop was discovered, with soap in it, which had evidently been made by the combination of oil and an alkali. This soap was still perfect, though it had been manufactured more than seventeen hundred years."

There is a curious account of this trade in a small pamphlet, printed for Nicholas Bourne, in 1641, entitled 'A Short and True Narrative concerning the Soap Business.' It contains an account of a patent granted to a Company for the exclusive manufacture of soap, under the title of the 'Governor, Assistants, and Fellows of the Society of Soapmakers of Westminster' (1622), on condition of their paying to his majesty 4*l.* per ton on 5000 tons annually. The manufacturers of that day (twenty in number) refused to join and acknowledge this Company; whereupon the Company obtained a proclamation forbidding, amongst other things, the sale of soap which had not been assayed by the Company. An information was then exhibited in the Star Chamber (1633) against sixteen London makers for opposing and affronting the letters patent; to which the defendants pleaded and demurred, &c., and after much discussion (all the defendants having been committed to prison for having put in their answer one day too late) the judges certified "all the answer except the first four words and last ten as fit to be expunged;" and it was decreed that the defendants be imprisoned during his majesty's pleasure, and fined in various sums from 1500*l.* to 500*l.* All were sent to prison. Fourteen remained there for forty weeks, and two died in prison. These tyrannical acts were followed by various proclamations and orders in council restricting the manufacture of soap except by the patentees, and fixing the price at which soap should be sold, and the materials from which it should be made. In 1635 many other soapmakers were committed to prison, and greater power was given by proclamation to the patentees upon their covenanting to pay 6*l.* per ton on five thousands tons annually. In a short time, however, the patentees, having "vexed the whole kingdom with their soap for three years," obtained a warrant from his majesty (1637) for 40,000*l.* for giving up the patent, and 3000*l.* for their houses, and obliged the soapmakers of London to pay them 20,000*l.* for their materials, so that they might have use of their trade again, of which they had been deprived. Little is known of the trade from this time to 1704, when Queen Anne imposed the first Excise duty. Several pamphlets and statements, on half-sheets, are to be found in the British Museum, containing petitions to be relieved from taxes, &c., but there is no account of the quantity manufactured.

As there are many kinds of fat and oil, and two very distinct kinds of alkali employed, it naturally follows that the soap will possess different qualities, and present different appearances, according to the ingredients.

Mottled soap is made from tallow, soda, a little 'kitchen-stuff,' a minute quantity of salt, and water. Its analysis is—alkali, 6·5; grease, 62·5; water, 31·0: total, 100. The tallow principally employed in the soap-factories of England is brought from Russia, and is exported from thence in a solid state in barrels. So large a quantity of this substance is used in England, that about thirteen hundred thousand cwts. are imported every year, yielding to the revenue somewhere about two hundred thousand pounds sterling. This supply is obtained principally from Russia, five-sevenths of whose exported tallow are sent to England. The tallow arrives in this country in a tolerably pure state, and requires no preparation previous to its employment in making soap. The heterogeneous substance known to domestic servants and 'dealers in marine-stores' by the name of kitchen-stuff, although very impure, is capable of being cleansed and refined, and used in the same manner and for the same purposes as tallow: it is heated in a copper, strained, and otherwise freed from the extraneous substances which are mingled with the tallow. It is only in the coarser kinds of soap that this material is used.

The alkali used for mottled soap is soda, the gradual changes in the production of which form a curious episode in the history of the soap manufacture. Although the form in which the alkali is used by the manufacturer is that of caustic soda, almost or entirely free from any acids, yet the state in which it is sold is that of a carbonate, more or less mingled with impurities. The barilla and kelp were until lately the only sources from which this alkali was derived; the one of foreign production, and the other British. Barilla is a kind of ash obtained by burning a South-European plant called the Salsola soda, which plant is cultivated with great care by the Spaniards and the Italians. A few years since there were 6000 tons imported annually from Spain, Sicily, and Sardinia; and formerly the quantity was much greater.

Kelp, another form of the carbonate of soda, alluded to above, is the ash remaining after the burning of sea-weed, and was introduced into the London market for the use of the soap trade by Mr. Hawes, the father of the members of the present firm. It contains only a little of the alkaline salt, but a large quantity of common salt, some salts of potash, and other substances. Previous to the year 1822, a duty of eleven or twelve shillings per cwt. being laid on barilla, a considerable quantity of kelp was made on the coasts of Ireland; and about a century ago from the present time the manufacture was begun in Scotland, where, in consequence, the land in certain localities by the sea-shore became greatly advanced in value, very large annual revenues being derived from estates

which had previously been wholly unproductive. Dr. M'Culloch gives a graphic account of the kelp manufacture in its most flourishing state:—"The kelp season had now commenced, and the whole shore was one continued line of fires; the grey smoke streaming away from each on the surface of the water, till, mixing with the breeze, it diffused its odoriferous haze over all the surrounding atmosphere. . . The weeds, being cut by the sickle at low-water, are brought on shore by a very simple and ingenious process. A rope of heath or birch is laid beyond them, and the ends being carried up beyond the high-water mark, the whole floats as the tide rises, and thus, by shortening the ropes, is compelled to settle above the wash of the sea, whence it is conveyed to dry land on horseback. The more quickly it is dried the better the produce; and when dry it is burned in coffers, generally constructed with stone, sometimes merely excavated in the earth. In Orkney the latter are preferred. As twenty-four tons of weed at a medium are required to form a ton of kelp, it is easy to conceive the labour employed for this quantity in the several processes of cutting, landing, carrying, drying, stacking, and burning."

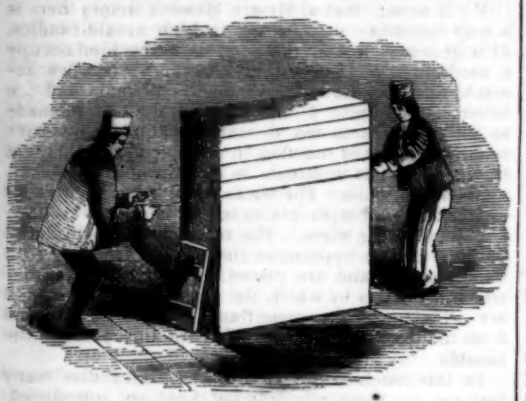
How strangely do variations in one branch of commerce affect the arrangements of another! Twenty years ago common table-salt was sold at four or five pence per pound; but when the duty was wholly removed, this price fell to one halfpenny. Manufacturers immediately turned their attention to this substance, as a source whence saleable commodities might be produced. Common salt is formed of chlorine and sodium, and by chemical agency the two can be separated, and each one made to combine with some other substance. Such has been the case in respect to the soda used in the soap-manufacture: by far the greater part of it is produced from the sodium which forms one of the ingredients in common salt, the decomposition of which in sufficient quantities to supply the soap and glass makers has for some years employed large capitals and many hundreds of workmen. This alkali, or 'white ash,' as it is called, made from salt, has driven kelp and barilla out of use. It is produced by treating common salt in a peculiar manner with sulphuric acid, from which there result muriatic acid and sulphate of soda; this sulphate is converted into a carbonate of soda by contact with carbon; and, lastly, the carbonic acid is driven from the carbonate, leaving the soda in a caustic state, and forming, when in solution with water, the liquor which soapmakers call a ley or lye. The ley is pumped out of the vats into the boilers, where it is mixed with the requisite quantity of tallow, and any other fatty substance which may be employed. The mixture is then heated by steam, and well boiled, an attendant stirring the mass occasionally. After a time the tallow is found to have combined with a portion of the ley, including all the alkali, and the remaining, or spent ley, is then of no further use in the process. It is pumped up from beneath the soap by a pump whose barrel descends to the bottom of the copper; and a fresh supply of ley is introduced. Again and again is this process repeated, new leys being introduced after the spent liquor is withdrawn, and the leys being used in a stronger or more alkaline state as the process advances towards completion. When the soap is nearly finished, that peculiar appearance to which it owes the name of 'mottled' soap is given to it by sprinkling upon the surface a small quantity of very dense and strong ley; this percolates slowly through the mass of soap, and leaves in its track those dark coloured veins which constitute mottling.

When the tallow and alkali have completely formed into soap, and have attained a proper consistency, the soap is laded from the coppers in buckets or pails, and conveyed to the frame-room, where it is poured into

[Filling Soap-frames.]

the frames. These frames have, until within the last few years, been made wholly of wood, but cast-iron frames are now occasionally used. The wooden frame is a kind of well or cistern, formed of a pile or heap of frames laid one on another. Each separate part consists of a rectangle of four bars of wood, measuring internally forty-five inches by fifteen; and these rectangles are laid one upon another to a height of ten or twelve feet. The bars of the rectangles are so neatly squared and smoothed, as to fit closely one upon another. The mottled soap is poured into these frames until full, and there allowed to remain till cold, which occupies more or less time according to the state of the weather.

When the mass of soap is cold and solidified, some iron fastenings, with which the rectangles of the frame were firmly bound together, are loosened, and the rectangles removed one by one, each one being lifted off the mass of soap. The soap is then presented to view as a compact body, whose dimensions are those of the



[Cutting Soap.]

interior cavity of the frame. Some of these masses of soap weigh three or four thousand pounds each. The next process is to cut the mass into slabs or slices about three inches in thickness. To effect this a man marks the surface of the soap with parallel lines, by means of sharp points inserted in a gauge-stick; and two men draw a piece of wire through the soap in the direction of each mark, one man holding the wire by handles at the ends, and the other guiding the wire to the proper marks. The slabs are next taken to a machine in the form of a hollow box open at the top, with vertical crevices passing from the top nearly to the bottom of two opposite sides. The slabs being ranged horizontally in this box, a piece of wire is passed down each of the crevices in succession, cutting through the slabs in its progress. As the crevices are about three inches apart, it follows that the slabs are cut into bars about three inches wide and the same in depth, the length being about fifteen inches. These are the bars in which soap is sold in the shops. After the cutting, the bars of soap are piled one upon another in the form of a wall, and kept in that state for a certain time until required to be removed from the factory.

For curd or white soap the same general description will suffice as applies to mottled, with some minor exceptions. As its whiteness is one of its chief characteristics, the tallow is selected with more care, and no ingredients are introduced which will be liable to deteriorate the colour. The process of mottling is in this case dispensed with; but the general outline of processes, such as the de-carbonising of the alkali, the melting and boiling of the ingredients, the framing, the cutting, &c., is much the same as in the manufacture of mottled soap.

Yellow soap is less expensive than white or mottled; and it owes this cheapness, as well as its colour, and certain properties which it possesses, to the large employment of palm oil and resin in its composition. Although resin is in appearance very different from tallow, yet it possesses the same property of melting and combining with an alkali, and forming a soap by the combination. The analysis differs little in pure soap from that of mottled, and consists generally of 6 alkali, 62 grease, 32 water. Inferior soap, although in appearance nearly the same, contains from 10 to 20 per cent. more water, the knowledge of which will, we hope, be useful to our readers. The nature and source of resin are simply as follows:—From several species of the pine-tree there exudes, when an incision is made, a grey-coloured semi-fluid substance, known in commerce by the name of turpentine. This turpentine has the distinctive names of Venice, Strassburg, Carpathian, Canada, Cyprus, and common turpentine, according to the countries whence it is brought, and the species of pine from which it exudes. By distillation common turpentine yields the oil or essence of turpentine, and the solid residue constitutes resin.

Palm-oil is obtained from the oil-palm of Guinea, cultivated in the western parts of Africa. The fruit of this tree is ovoid, about the size of a pigeon's egg, with its outer fleshy covering of a golden yellow colour. The oil is obtained by bruising the fleshy part of the fruit, and subjecting the bruised paste to boiling water in wooden mortars: an oil of an orange-yellow colour separates, which concretes, when cool, to the consistence of butter, and has, when fresh, the smell of violets, and a slightly sweetish taste. The Africans use this oil in cookery, and for anointing the body; but when imported into England, it is used in soap-making, in perfumery, and in medicine, for which purposes two or three hundred thousand cwts. are used annually. When brought to the soap-factory it is in casks in a solid state; and the mode adopted for extracting it, is to place the cask over a trough with its bunghole downwards, and to pass a steam-pipe into the cask, by which means the palm-oil is brought to a liquid state and made to flow out of the cask. The oil is afterwards conveyed to a vat, where it is bleached by a chemical process. The use of this oil in soap, or wherever it can be introduced, is a matter of as much or more importance to the philanthropist and the statesman than to the soap manufacturer. The latter looks at it merely as a good and cheap ingredient; the philanthropist views it as the most powerful instrument he can employ in the abolition of the traffic in slaves; the statesman feels that it secures to our manufacturers a most lucrative barter trade, free from fiscal regulations, which impede our commerce with old states. Every cargo of oil bought with our manufactures does more to impede the traffic in slaves than a host of treaties and protocols with European states.

The mode of preparing the alkali for yellow soap, the process of melting and boiling it with the tallow and resin, and the general routine of manufacture, differ but little from those relating to mottled soap. The frames used are, however, very different. They are made of five pieces of cast-iron: one for the bottom, two for the sides, and two for the ends. By a simple mode of fastening at the edges, the whole can be quickly put together, so as to form a sort of well or cistern, between four and five feet high, forty-five inches long, and fifteen wide. Into these frames the yellow soap is poured, the contents of each being about fifteen cwt. These frames are not only put together and taken to pieces with more ease than the wooden frames, but the iron being a good conductor of heat, the process of cooling is effected more rapidly. The cutting of yellow soap into slabs and bars is effected in the same way as that of mottled.

Soft soap, a commodity which is almost exclusively used in the woollen manufacture, differs considerably from hard soap in its ingredients, its consistence, and its general appearance. Both the alkaline and the oleaginous ingredients are different from those employed in hard soaps; since potash is employed instead of soda, and oils are more largely used than tallow. This soap, when of good quality, consists of alkali 9, oil and tallow 42, water 49; total 100. The potash employed in the soap-manufacture is brought prin-

cipally from Canada and the United States.* The carbonate of potash is rendered caustic, that is, free from carbonic acid, by a process similar to that adopted for the soda alkali; and several of the vats in the soap factory are employed for this purpose.

The oils employed in soft soap, whether whale, seal, olive, or linseed, are procured in the usual way, from the blubber of the two former, the fruit of the third, and the seed of the fourth, and need no particular description. Nor does the mode of combining the ingredients to form this kind of soap require any lengthened notice. It may, however, be remarked, that instead of supplying successive portions of alkaline ley to the boiler, and pumping out the spent ley at intervals, the whole of the ley is supplied at once, and kept boiling with the oils and tallow until the soap is made. The use of the tallow employed is to give consistency to the oil soap, the general quality of which is indicated by the gradual formation of white specks throughout the soap, which arise from the combination of the tallow with the salts of potash. Soft soap, as its name imports, has a consistence which renders useless the processes of framing and cutting: it is placed in barrels or casks, when finished, and in that state sent from the factory.

With respect to the large variety of soaps known as 'toilet,' 'fancy,' or 'perfumed' soaps, little need be said here. They are generally made from good white soap, which is remelted and modified in its form and appearance by perfumes and other substances. None of these fancy soaps are made at this factory; they are either the production of persons who devote their attention principally to the manufacture, or else of perfumers, who apply the fanciful terms—'soap à la rose,' 'soap au bouquet,' 'cinnamon soap,' 'Windsor soap,' 'musk soap,' 'almond soap,' &c., to their manufactures.

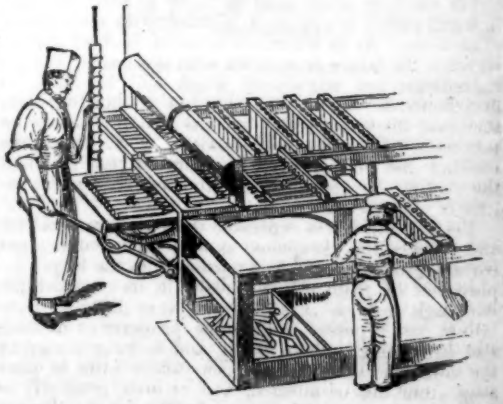
Let us now turn our attention from the manufacture of soap to that of candles, a branch of art exceedingly simple and free from technical difficulties.

Candles can be made from any fatty substance which, at ordinary temperatures, is in a solid state: wax, spermaceti, and tallow being the usual substances employed. That very essential part of a candle—the wick—performs an office which involves a scrap of philosophy not always well understood. The wick is composed of a dozen or more fibres of soft cotton, ranged side by side, and having just sufficient twist given to them to make them cling together. The threads are not so close together but that oil, or tallow in a melted state, will ascend between them, by virtue of that capillary attraction which will cause a piece of loaf-sugar to become wet throughout if placed on a wet spot. When a candle is lighted, the heat melts the upper part of the tallow, which then ascends between the fibres of the wick, and furnishes minute streams of combustible matter as fast as the oxygen of the air will consume it in the form of flame. The current of air constantly supplying oxygen to the flame, also performs an important duty. It keeps the outer surface of the tallow cool, causes the formation of the 'cup' which contains the melted tallow that otherwise would run down and disfigure the candle, and render it unfit for use. The tallow, then, is the combustible matter, and the wick is the series of little tubes through which it ascends to the flame.

Wax-candles are not made at the factory to which our attention is directed, but a word or two may be said as to their manufacture. The wicks being cut and twisted, a set of them is suspended over a basin or vessel of melted wax, which is taken up by a large ladle and poured from time to time on the tops of the wicks. The melted wax, as it flows downwards, adheres to and covers the wicks throughout their length. This is repeated until a sufficient weight of wax has been gathered upon each. After the candles are sufficiently cooled, they are rolled upon a smooth table in order to give them a perfectly cylindrical form, and are then polished.

We have said that at Messrs. Hawes's factory there is a very ingenious machine for making mould-candles. It is generally known that candles of this kind occupy a medium rank between wax and 'dip' candles, resembling the former in regularity of shape, and the latter in material. Usually mould-candles are made as follows:—From ten to sixteen cylindrical pewter moulds are placed together in a wooden frame, so that their upper ends terminate in a kind of trough common to the whole. The wicks are inserted and kept firmly in their proper places in the centre of each cylinder by strong wires. The frame being then placed with the trough uppermost, the moulds are filled with melted tallow, and are placed in the air to cool, after which the wires by which the wicks have been fixed are withdrawn, the superfluous tallow is removed from the trough, and the candles are pulled out of the moulds.

In this machine for making mould-candles many features of an entirely different kind are introduced. The wick, instead of being cut off to the exact length required for each candle, is wound on a reel in lengths of one hundred feet, of which there are as many as there are moulds. In a kind of case or frame are enclosed a certain number of moulds, with a reel of cotton attached to each. A portion of cotton is unwound from each reel, and made to pass through a mould, the lower end of which is only large enough to admit of the passage of the wick, and is held in its place by a pair of forceps. The frame or case is then brought under a kind of box or cistern, into which melted tallow of a fine and pure quality is poured. By turning a handle, the melted tallow is allowed to flow out of as many little holes as there are moulds, and thus the moulds become filled. As the moulds fill, a man pulls the wick in each mould straight and uniform, by laying hold at the lower end. When one set is filled, the frame which contains them is wheeled along a kind of railroad, and another is filled in a similar manner. As soon as the tallow has solidified, a workman disengages the forceps, and scrapes the superfluous material from the upper ends of the moulds. The frame is then turned so as to bring the moulds into a horizontal position; and by a beautiful adaptation of

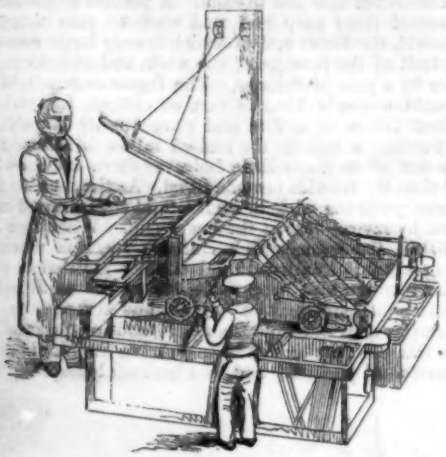


[Morgan's Mould-Machine. *a*, mould-candles; *b*, moulds, through which the candles are pushed by the rods *c*.]

* See 'Penny Magazine,' No. 573, for an account of the manufacture of potash.

machinery, the candles are forced out of the moulds and thrown on a table in parallel lines. The wicks in these candles are still connected with the coils of cotton wound round the little reels in the frames or cases; but the whole are severed in a few seconds by the attendant workman, when the candles are finished. All the mould-frames move along a double line of railroad, and the whole of the arrangements are so judiciously made that a man and a boy can manage the whole, and produce a surprising number of mould-candles in a short time.

The common 'dip' or 'store' candles are made, as most persons are aware, by dipping the wicks into a vessel containing melted tallow, a small coating of which adheres to the cotton fibres, as do likewise the subsequent coatings to that first laid on. The wicks are prepared at the factory in the following manner:—Balls of cotton, each weighing about three pounds, are procured from Manchester or the surrounding district, the cotton being previously made into a loose roving or cord, consisting of a dozen or more threads slightly cohering. These cords (if we may so term them) are of different thicknesses, according to the size of the intended wick; the wick for those candles known as 'eights,' for example, containing thirteen or fourteen threads. A great number of these balls are carried to the wick-making machine, and put into a box or drawer. A man takes the ends of all these balls, doubles a portion of each cord round a broach or stick, and by a sharp blade (somewhat like that by which tobacco is shred) cuts all the cottons to the

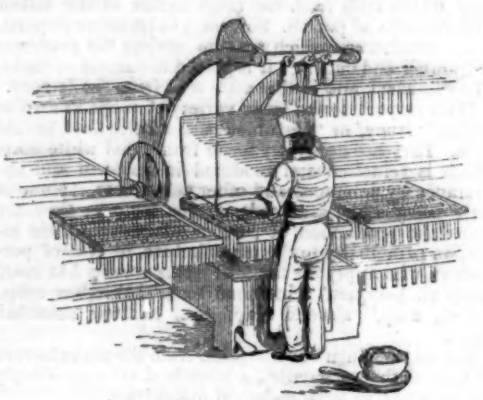


[Machine for cutting the Wicks for Dip candles.]

proper lengths for wicks, giving to the whole of them, by the action of the machine, a slight twist before he removes them. One stick-full of wicks being thus made, another is prepared in a similar manner; and thus the preparation of wicks proceeds with great rapidity. By this machine one man will prepare the wicks for fourteen or sixteen makers. The wicks for some candles are twisted or spun in a particular manner, but this is effected at the cotton-manufactory.

In making dip-candles by hand, a man takes three broaches or sticks, each containing as many wicks as will suffice for about two pounds of candles, and holding them parallel and horizontal, dips the wicks into a trough of melted tallow. This he does two or three times, and then lightly draws the lower ends of the wicks over a sloping board, to remove the drainings of tallow. These three broaches are hung up for the tallow to dry and harden; another set are similarly treated, and so on. When the first dipping or 'lay' is dry, the coated wicks are dipped a second time; afterwards a third and a fourth; the number of repetitions depending on the size of the intended candles, and being about twelve for the candles known as 'twelves.'

By the machines now employed, however, the operations are surprisingly hastened. At the time we witnessed the processes at the factory, one of the machines was employed in making 'twelves,' and was thus arranged:—Twenty-four candles were hung on each broach or stick; thirty broaches were ranged side by side, and formed an assemblage called a 'frame;' and thirty-six of these frames were attached to or suspended from the machine, so that the entire number of candles attached to the machine amounted to nearly twenty-six thousand, the whole of which were made, by one man and a boy, between six o'clock in the morning and four in the afternoon of the same day. In the front of each



[Dipping-machine.]

machine is a vessel of melted tallow, and the thirty-six 'frames' are so attached to the machine, that each can, in its turn, be brought over the tallow vessel, and the candles dipped in it. A piece of apparatus, called a 'wiping-board,' is, after each dipping, ingeniously brought down, by a lever moved by the foot, over the cistern; the ends of the candles are wiped on it, and the board rapidly re-ascends to its former position. There are two varieties of dipping-machines used at this factory, differing somewhat in the mechanical arrangement whereby the 'frames' are brought over the melted tallow, but similar in respect of the great saving in time and labour occasioned by their use. When the candles have been dipped a sufficient number of times (which is known by the use of a kind of steelyard or balance-weight indicating the total weight of all the candles on the machine), and are properly hardened, they are weighed up into pounds, and hung upon strings, the former by men, and the latter by boys, each of whom exhibits great dexterity and quickness in the operation.

Those long and slender candles known as 'rush-lights' differ only from common dip-candles in the material of which the wick is made. Instead of fibres of cotton, the wicks are made of dry rushes, which have a loop made at one end by piercing the rush with a sharp instrument, and are then cut to the required length by a gauge or knife. The dipping is conducted much in the same manner as for common candles, except that, from the comparatively small number required, the machine is not employed. Taking the 'moulds,' 'dips,' and 'rushlights' together, there have been as many as twenty millions of candles made in this factory in one year.